

1)

$$\text{I) } \frac{V_1 - V_A}{R_1} = \frac{V_A - V_2}{R_2} \Rightarrow \frac{V_1}{R_1} + \frac{V_2}{R_2} = \left(\frac{1}{R_1} + \frac{1}{R_2} \right) V_A \Rightarrow \frac{V_1}{R_1} + \frac{V_2}{R_2} = \frac{R_1 + R_2}{R_1 R_2} V_A$$

$$\frac{R_2 V_1 + R_1 V_2}{R_1 R_2} = \frac{R_1 + R_2}{R_1 R_2} V_A \Rightarrow V_A = \frac{R_2 V_1 + R_1 V_2}{R_1 + R_2} //$$

$$\text{II) } s C_1 (V_1 - V_A) = \frac{V_A}{R_3} \Rightarrow s C_1 V_1 = \left(\frac{1}{R_3} + s C_1 \right) V_A \Rightarrow s C_1 V_1 = \frac{s C_1 R_3 + 1}{R_3} V_A$$

$$s C_1 V_1 = \frac{s C_1 R_3 + 1}{R_3} \cdot \frac{R_2 V_1 + R_1 V_2}{R_1 + R_2} \Rightarrow s C_1 V_1 = \frac{s C_1 R_2 R_3 V_1 + s C_1 R_1 R_3 V_2 + R_2 V_1 + R_1 V_2}{R_3 (R_1 + R_2)}$$

$$(s C_1 R_1 R_3 V_1 + s C_1 R_2 R_3 V_1 - s C_1 R_2 R_3 V_1 - R_2 V_1) = s C_1 R_1 R_3 V_2 + R_1 V_2$$

$$(s C_1 R_1 R_3 - R_2) V_1 = (s C_1 R_1 R_3 + R_1) V_2 \Rightarrow \frac{V_2}{V_1} = \frac{s C_1 R_1 R_3 - R_2}{s C_1 R_1 R_3 + R_1}$$

$$H(s) = \frac{V_2}{V_1} = \frac{s - \frac{R_2}{C_1 R_1 R_3}}{s + \frac{1}{C_1 R_3}}$$

$$H(j\omega) = H(s) / s = j\omega \Rightarrow H(j\omega) = \frac{j\omega - \frac{R_2}{C_1 R_1 R_3}}{j\omega + \frac{1}{C_1 R_3}}$$

$$|H(j\omega)| = \frac{\sqrt{\left(\frac{R_2}{C_1 R_1 R_3} \right)^2 + \omega^2}}{\sqrt{\left(\frac{1}{C_1 R_3} \right)^2 + \omega^2}}$$

$$\angle H(j\omega) = \pi - \tan^{-1} \left(\frac{\omega}{\frac{R_2}{C_1 R_1 R_3}} \right) - \tan^{-1} \left(\frac{\omega}{\frac{1}{C_1 R_3}} \right)$$

